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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/781,920	02/20/2004	Odo Wunnicke	2004 SP 00138 US	5298
48154	7590	08/01/2007	EXAMINER	
SLATER & MATSIL LLP			RAYMOND, BRITTANY L	
17950 PRESTON ROAD				
SUITE 1000			ART UNIT	PAPER NUMBER
DALLAS, TX 75252			1756	
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 10/781,920	Applicant(s) WUNNICKE ET AL.	
	Examiner Brittany Raymond	Art Unit 1756	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 12 July 2007.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-5 and 9-22 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-5 and 9-22 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 20 February 2004 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
 2. Ascertaining the differences between the prior art and the claims at issue.
 3. Resolving the level of ordinary skill in the pertinent art.
 4. Considering objective evidence present in the application indicating obviousness or nonobviousness.
2. Claims 1-5, 9-11, 13, 14 and 16-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Singh (U.S. Patent 6479820) in view of Hyon (U.S. Patent Publication 2004/0072108).

Singh discloses a method for reducing electrostatic charge on a photoresist pattern comprising: applying a photoresist layer onto a substrate, exposing the substrate to actinic radiation to cause a chemical transformation in the desired regions of the photoresist, developing the photoresist to form a pattern, optionally rinsing the photoresist with deionized water, and applying a positive ion carrier, such as a cationic surfactant solution (Column 3, Line 53-Column 4, Line 50 and Column 7, Lines 1-6) as recited in claims 1, 2, 4, 9, 16, 17, 19 and 20 of the present invention. Singh states that

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after development of the photoresist, negative electrostatic charges may accumulate on the patterned photoresist and a positive ion carrier is added to reduce these charges (Column 4, Lines 46-50 and Column 5, Lines 14-29), which means that some negative charge will still remain, as recited in claims 1 and 16 of the present invention. Although Singh does not state that the cationic surfactant will form a salt, as recited in claims 1 and 16 of the present invention, it is inherent for this to occur because cationic surfactants are made from salts and as the solutions dry and return to a solid state, they will turn into a salt again. Singh discloses that the photoresist layer is preferably a positive photoresist (Column 4, Lines 6-7), and that it can be a 157 nm or 193 nm sensitive photoresist, or a chemically amplified photoresist (Column 3, Lines 63-67), as recited in claims 10, 11 and 13 of the present invention. Singh also discloses that the positive ion carrier is contacted with the patterned photoresist layer for a duration of 1 second to about 1 hour (Column 5, Lines 64-66), which is within the range of claim 5 of the present invention.

Singh fails to disclose that the resist layer is dried after the developing and rinsing steps, that the cationic surfactant is contained in the first rinsing medium, and that the concentration of the cationic surfactant is chosen so that the rinsing medium within the patterns of the photoresist form a 90 degree angle with the sidewalls of the photoresist pattern.

Hyon discloses a method of forming a resist pattern on a semiconductor device, comprising the steps of: coating a photoresist onto a wafer, exposing the wafer, developing the exposed photoresist with developer so that a pattern is formed, cleaning

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the wafer with deionized water which contains a fluorocarbon surfactant to prevent pattern collapse, as stated in the abstract, and evaporating the liquid off of the wafer (Claim 2), as recited in claims 1, 3, 16 and 18 of the present invention. Hyon discusses in the background that pattern collapse depends on surface tension of the rinse liquid, the contact angle between the resist pattern and the rinse liquid, and the pattern dimensions (Paragraph 0005). Hyon states that a previous invention aimed to control resist pattern collapse by making the contact angle 90 degrees (Paragraph 0008), as recited in claim 14 of the present invention. Hyon states in the summary that the purpose of the invention is to use a new rinse liquid to reduce pattern collapse. Therefore, Hyon is using the rinse liquid to lower surface tension and make the contact angle as close to 90 degrees as possible.

It would have been obvious to one of ordinary skill in the art, at the time of invention by applicant, to have included the cationic surfactant in the first rinsing solution and to have included a drying step in the process of Singh, as suggested by Hyon, because Hyon teaches that the cationic surfactant can be used during or after the first rinsing step in order to prevent pattern collapse and that a drying step is necessary to finish forming the photoresist pattern. It also would have been obvious to one of ordinary skill in the art, to have used the surfactant solution to form a contact angle of 90 degrees within the resist patterns, as suggested by Hyon, because Hyon teaches that this reduces collapse force and prevents resist pattern collapse.

3. Claim 12 is rejected under 35 U.S.C. 103(a) as being unpatentable over Singh (U.S. Patent 6479820) in view of Hyon (U.S. Patent Publication 2004/0072108) as applied to claims 1-5, 9-11, 13, 14 and 16-20 above, and further in view of Messick (U.S. Patent 6451510).

The teachings of Singh and Hyon have been discussed in paragraph 2 above.

Singh and Hyon fail to disclose that the structure elements of the resist mask have an aspect ratio of greater than 3.

Messick discloses a method for developing a photoresist pattern on an electronic component substrate comprising: coating a photoresist film on an electronic component substrate, exposing the photoresist film, developing the photoresist film with a developer composition to form a photoresist pattern, rinsing the developed substrate with a rinse water solution containing an anionic surfactant, and drying the developed substrate (Claim 1). Messick also discloses that the semiconductor wafers having small feature sizes are characterized by high aspect ratios greater than about 3 (Column 4, Line 15), as recited in claim 12 of the present invention.

It would have been obvious to one of ordinary skill in this art, at the time of invention by applicant, to have modified the process of Singh and Hyon by making sure that the semiconductor wafers having small features sizes are characterized by aspect ratios greater than 3, as suggested by Messick, because semiconductors having an aspect ratio greater than 3 have a high chance of pattern collapse, which is what the present invention is trying to prevent.

4. Claim 15 is rejected under 35 U.S.C. 103(a) as being unpatentable over Singh (U.S. Patent 6479820) in view of Hyon (U.S. Patent Publication 2004/0072108) as applied to claims 1-5, 9-11, 13, 14 and 16-20 above, and further in view of Torek (U.S. Patent 6599683).

The teachings of Singh and Hyon have been discussed in paragraph 2 above.

Singh and Hyon fail to disclose that the concentration of the cationic surfactant in the rinsing medium is less than the critical micelle concentration.

Torek discloses a method for patterning a photoresist comprising: applying a photoresist to a substrate, selectively exposing the photoresist to actinic radiation, developing the photoresist with a developer that includes a surfactant to prevent pattern collapse as stated in the abstract, and which can be cationic, as stated in line 52 of column 3 of the detailed description, rinsing the photoresist pattern, and drying the photoresist pattern (Claim 45), as recited in claim 1 of the present invention. Torek also discloses that the concentration of the surfactant is less than the critical micelle concentration (Column 3, Line 45), as recited in claim 15 of the present invention.

It would have been obvious to one of ordinary skill in the art, at the time of invention by applicant, to have used a cationic surfactant with a concentration less than the critical micelle concentration, as suggested by Torek, in the process of Singh and Hyon because Torek teaches that concentrations less than the critical micelle concentration allow the surfactants to prevent pattern collapse more efficiently.

5. Claims 21 and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Singh (U.S. Patent 6479820) in view of Hyon (U.S. Patent Publication 2004/0072108) as applied to claims 1-5, 9-11, 13, 14 and 16-20 above, and further in view of Liu (U.S. Patent 6114099).

The teachings of Singh and Hyon have been discussed in paragraph 2 above.

Singh and Hyon fail to disclose that the cationic surfactant is dodecyltrimethylammonium bromide or tetradecyltrimethylammonium bromide.

Liu discloses a technique for protecting patterned multilayer films comprising the use of dodecyltrimethylammonium bromide to block the further growth of the second set of layers on the sites of the first set of layers where the second set is placed (Column 8, Lines 30-44), as recited in claims 1 and 16 of the present invention.

It would have been obvious to one of ordinary skill in the art, at the time of invention by applicant, to have used dodecyltrimethylammonium bromide (DTAB) as the cationic surfactant, as suggested by Liu, in the processes of Singh and Hyon because Liu teaches that DTAB is used to prevent photoresists from sticking to one another, which is similar to the process of forcing pattern structures of a photoresist apart in order to prevent pattern collapse.

Response to Arguments

6. Applicant's arguments, filed 6/13/2007, have been fully considered and are persuasive. Therefore, the rejection has been withdrawn. However, upon further consideration, a new ground(s) of rejection is made in view of a newly found prior art reference.

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The reference, Singh, has been added to teach the formation of negative charges on the resist pattern after development. Singh uses a cationic surfactant to reduce the negative charge on the pattern, leaving the cationic surfactant and a small amount of negative charge left on the resist patterns, as recited in the independent claims 1 and 16 of the present invention.

Dependent claims 2-5, 9-15 and 17-22 are rejected for being dependent on the rejected independent claims and based on the new grounds of rejection.

Conclusion

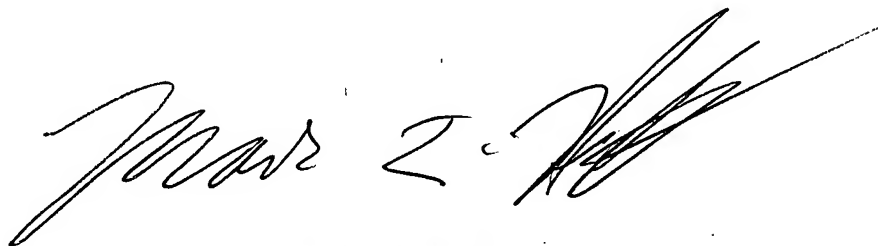
Any inquiry concerning this communication or earlier communications from the examiner should be directed to Brittany Raymond whose telephone number is 571-272-6545. The examiner can normally be reached on Monday through Friday, 8:00 a.m. - 4:30 p.m. EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark Huff can be reached on 571-272-1385. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

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